



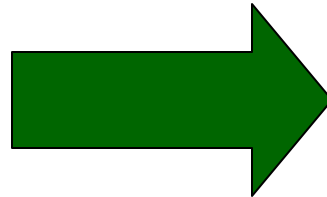
# **Panel Comments: The Future of Software and Software Research**

**Barry Boehm, USC  
SDP New Visions Workshop  
December 13, 2001**

- **Emerging software technology needs**
- **Promising new technologies**
- **Technology transition barriers and enablers**

# A Network-Centric Example: *Future Combat Systems*

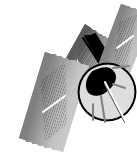
From This...



To This...

**Network Centric Distributed Platforms**

Small Unit UAV



Other Layered Sensors



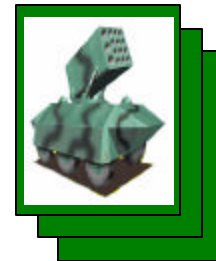
Robotic Sensor



Robotic Direct Fire

Network Centric Force

Distributed Fire Mechanisms



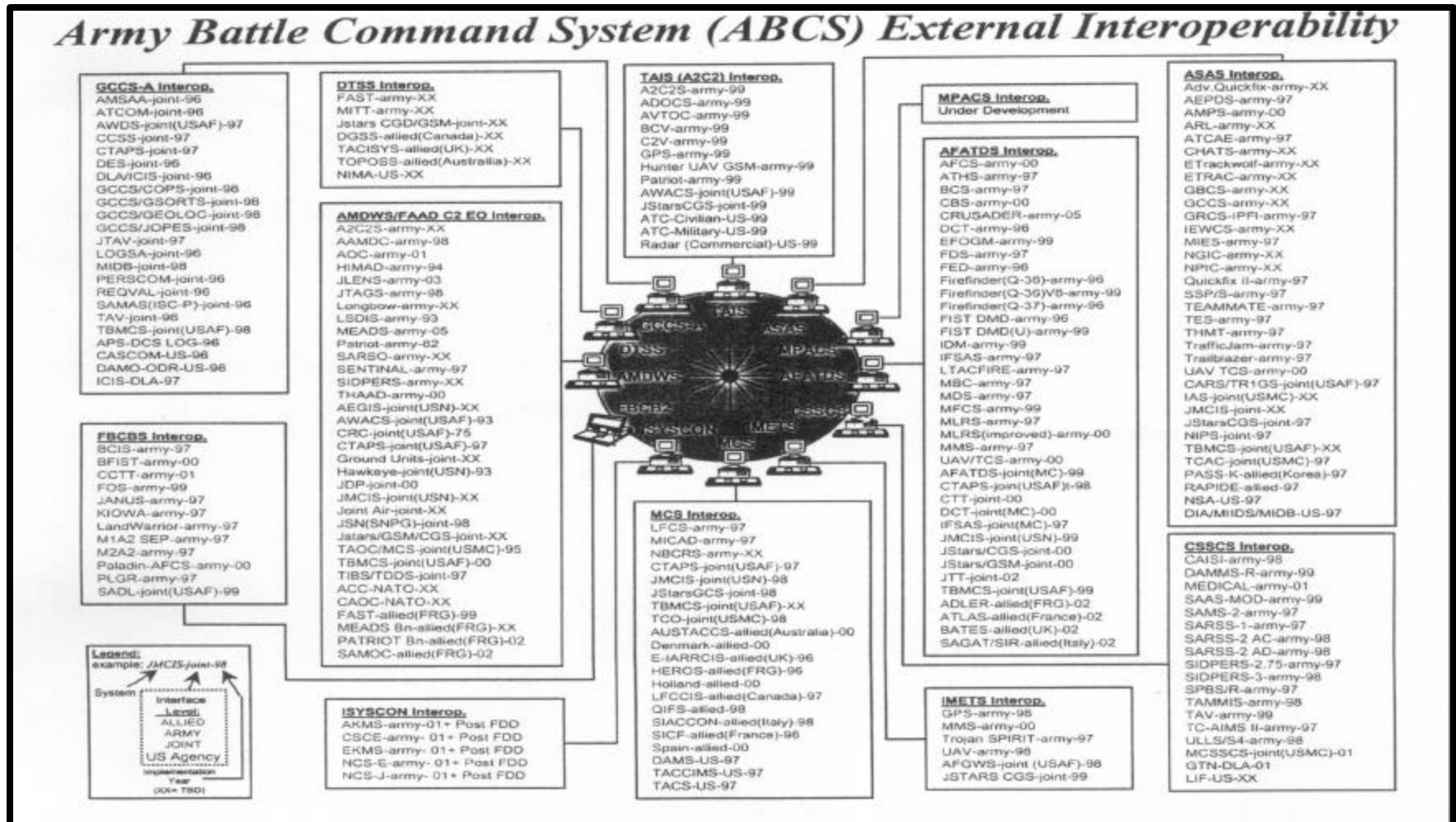
Robotic NLOS Fire



Manned C2/Infantry Squad

**Exploit Battlefield Non-Linearities using Technology  
to Reduce the Size of Platforms and the Force**

# FCS Product/Process Interoperability Challenge



# Future Software S&T: *What's Missing?*

- Scalable techniques for analysis, definition, development, and management of complex, heterogeneous systems of systems
  - Architectural analysis
  - Multiprocess synchronization
  - Metrics; outcome analysis
  - Distribution, mobility
  - Change propagation
  - Group collaboration
- Techniques for simplifying complex systems of systems
- Integrating opaque, imperfect, uncontrollably changing, externally-developed software components
- Software quality attribute tradeoff analysis
- Integration of multiple software product, process, & property views
- Coordination of automated, semiautomated and human agents
- Doing all of the above in an adversarial, competitive environment

# Promising New Technologies

- Aspect oriented software development
- Value-based design
- Architecture-based performance engineering
- Self-stabilizing software
- Frameworks and Patterns
- Model-based product/process engineering
- Model-based testing
- Lightweight formal methods
- Experience-based process automation

# Technology Transition Rate Multipliers

- USC TECTRAMO estimation model

1. Competition-criticality
2. Impact on current operations, power bases
3. Number of concurrent innovations involved
4. Adopter change/risk-aversion
5. Payback realization speed
6. Regulatory obstacles or incentives
7. Degree of executive support
8. Factor Endowment (human, knowledge, capital, infrastructure)

# Factor Endowment: Virtual Laboratories

## - Example: NASA High Dependability Computing testbeds

- Create virtual laboratories for research and experimentation at scale to accelerate transition by providing early validation
- Assess technology readiness, scalability, generality by experimental use in staged mission-representative testbeds
- Multi-stakeholder participation
- Enable technology validation across lifecycle
- Realism and reality transfer: scale, complexity, (sanitized) artifacts
- Evaluate technologies, artifacts, designs, operational concepts, methods, theories, tools via empirical methods
- Accessible cost, value, and impact data via open-source knowledge repositories